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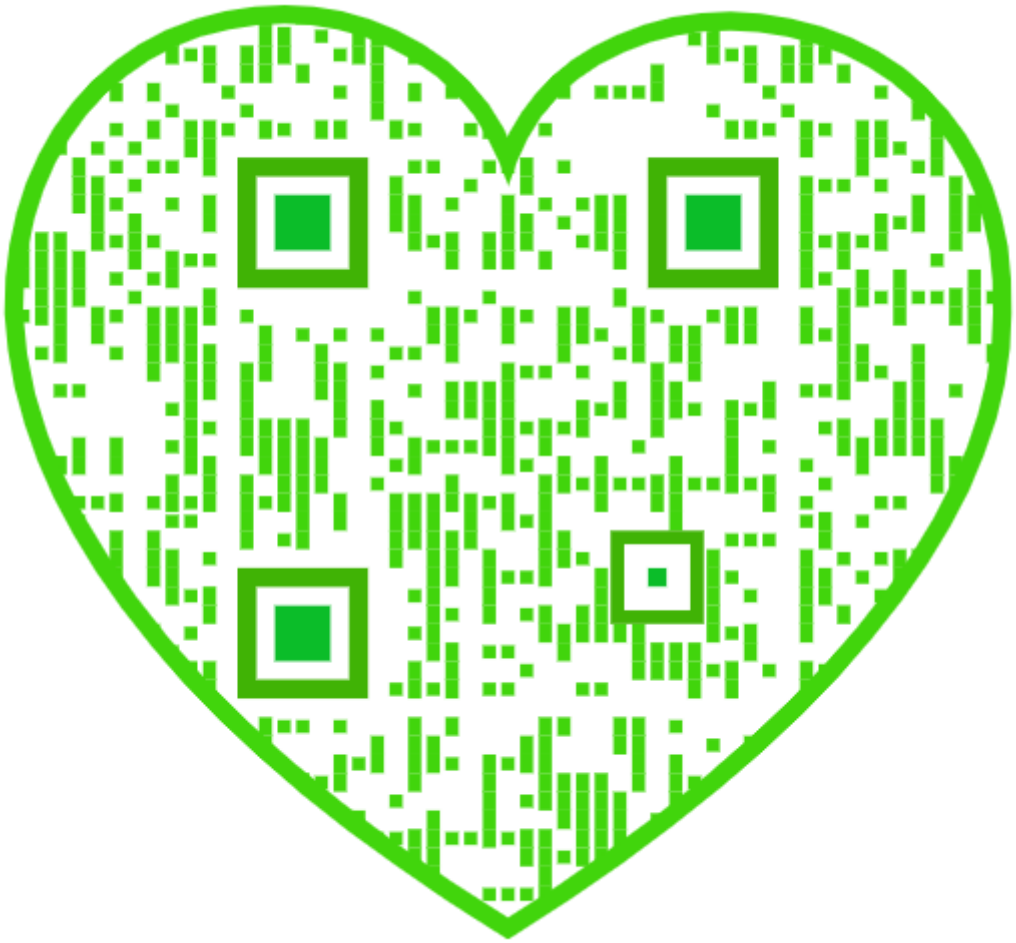

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CERTAIN FEATURES OF GERMAN FORESTRY

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HOMER D. HOUSE

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CERTAIN FEATURES OF GERMAN FORESTRY

BY HOMER D. HOUSE

German forestry, perhaps because it is the most scientifically developed of any in Europe, has been for many years a source of deep interest and profitable study on the part of American students of forest management and utilization. There are those who predict for America, before many decades shall have passed, forestry conditions similar to those now existing in Germany. That we may in time develop in America a scientific as well as practical scheme of forestry, no one can doubt, but that it will in any way resemble German methods seems wholly improbable, unless we can make over our methods of taxation and administration of public lands. German forestry pays its way. Forestry is a sort of government trust in Germany. Without the connivance of the government it would no more pay to grow timber for any purpose other than for firewood in Germany than in the United States. Germany imports vast quantities of timber, but the duty is so adjusted that it is a paying proposition for the German states to invest money in long-time rotations of forest crops. With a high stumpage value, the owners of the German forests, either private or state, can afford to make a more complete utilization of all the products of the forest, can afford more careful methods in logging, and can afford the expense of replanting and protection. The entire expense is put where it belongs, that is, on everybody, because everybody is directly or indirectly a consumer of forest products. I wonder how many advocates of conservation of our forest resources in the United States realize that low tariff on imported timber means low stumpage values in our own forests and that low stumpage values mean waste and high speed in lumbering?

The German forests present an almost endless variety of conditions with respect to management and utilization, and the observant forester will find therein much food for thought in connection with forest conditions which prevail at home and he will discover therein many new ideas that will be of benefit to him in coping with American problems in forestry.

The following sketches are taken at random from my notes with a view of presenting characteristic and interesting methods of procedure in sylviculture, management and utilization, particularly of such ranges in the German forests as may well pay any student of forestry to visit who has the opportunity to travel.

1 THE PINERIES OF EBERSTADT NEAR DARMSTADT.

The forest range of Eberstadt consists of both town and state (Hesse-Darmstadt) forests, some 2500 acres, under the direction of Geh. Forstrat Joseph, an elderly man of kindly and delightful personality. The activity of the state in buying up odd or unproductive strips of privately owned land has resulted in the same policy by the town of Eberstadt, so that there are few privately owned forests here. Natural seed regeneration of the Scotch pine, which is the principal tree here on the sandy plains of the Rhine valley, has not done well. This is in striking contrast to the pineries of Ysenburg, 20 miles north, where the luxuriant natural regeneration is depended upon almost wholly for reforestation.

The rotation at Eberstadt is approximately 120 years, at which time the larger trees attain an average diameter, breast high, of 12 to 16 inches. The cuts are made in winter and in the succeeding winter the ground is dug over to a depth of about 14 inches, the best soil of the forest floor being turned under and the poor sand from below placed on top. This will force the roots to go deeper for their food. In April, one year old seedlings of Scotch pine are planted, and between the rows, in May, potatoes will be cultivated. This method of "tongya" gets rid in a large measure of the weeds and soil fungi which might be harmful to the young pine, especially Hysterium pini. At the time of the logging operations there were left standing, in the majority of cases, about eight of the best trees to an acre, to run through the next rotation as "veterans." In addition to the increment yield of these trees, which takes place practically without injury to the growth of the next rotation, the price increment of these veterans rises from a stumpage value of under $40 to over $60 a thousand.

The cost an acre of reforestation at Eberstadt is:

To dig over the soil	$27.50
For plants and planting	10.50
For potatoes	4.00
For planting and cultivating potatoes	6.00
For weeding, paris-greening, etc	8.00
Making a total gross expense of	$56.00

About 1400 pine seedlings are planted to the acre and about 6 hundredweight of potatoes are used on each acre. The net returns from the potatoes usually average about $20 an acre, which leaves a net planting expense of $36 an acre. Adding this to the value of the land, which is here as high as $100 to $150 an acre, to obtain

Plate I

Various stages of Scotch pine regeneration as practised at Eberstadt

the amount of the original investment, and figuring at 6 per cent compound interest and including also taxation and protection, one can imagine that at the end of 120 years the value of the Scotch pine produced will scarcely yield a profitable return upon the investment, not even with the present high value of timber in Germany.

As the oberförster, however, is required by regulation to replant, the net planting expense of $36 is charged by him to the logging expense of the last rotation and the new growth starts with a clean bill of health, financially. It is burdened with only the soil value, taxation and protection expense upon the books; and the deduction of $36 from the receipts of the sale of timber does not seriously effect the profitable appearance of the forest accounts. In other words, the unique thing about this range is that merely by the method of bookkeeping the forest investment represented at Eberstadt is a profitable one instead of a loss, and the planting expense does not hang with its accruing interest as a burden upon the financial success of the next rotation, to be eliminated, possibly, only by the first or second thinnings.

Because of the abundance of rabbits and deer, all the young plantations must be fenced. Woven wire fences are necessary, for which the annual expense on this range of 2500 acres is $500, but the item does not appear in the planting expense. There is an annual revenue from hunting privileges of $2000, and here again the oberförster shows his keen business ability in keeping down the value of the investment by charging this fencing expense to the revenues received from hunting privileges, rather than to the cost of reforestation. As a result of all this the range yields an annual net revenue of something over 3 per cent. It must be borne in mind, however, that the gross receipts are very large and that the cause of the low net revenue which prevails in practically all German forests (rarely rising to 6 per cent) is due to the relatively high valuation placed upon the soil in estimating the value of the investment.

2 THE PINERIES OF YSENBURG

Ysenburg is situated on the level, sandy plain of the Rhine valley, a few miles south of Frankfurt. Three or four centuries ago the holdings of the princes of Ysenburg constituted one of the hundreds of small principalities of the old German empire. Napoleon reduced these to but a few in number and the Landgraf (now Grossherzog or Grand Duke) of Hesse-Darmstadt received dominion over Ysenburg. The princes, however, retained their land, if not their

political importance, until they were forced, in order to satisfy their creditors, to sell out to the government in 1890 at a price of $300 an acre. Their forest lands embraced about 4000 acres within a solid boundary and the event was notable in being one of the few large sales of timber land in Germany. A few years later the state government sold a slice of this land containing 125 acres suitable for villa sites at a price of $3000 an acre, the stumpage not included. This strip is a fine stand of Scotch pine, bordering the macadam road leading west from the station of Ysenburg. It was seed planted on very poor sandy soil, some 70 years ago.

Some of the former princes of Ysenburg apparently realized the importance of careful forest management. The records of this particular forest show that in 1761 it consisted of decrepit beech and oak woods, the remnant of the primeval Rhine valley forest which was entirely oak and beech with no pine, the pine being introduced to reforest the drifting sand which followed the deforestation of the Rhine valley in many places a century and a half ago. These stands of Ysenburg in 1761 had been ruined by continuous cutting and pasturage. In 1762 regulations were promulgated which provided that:

The best oak and beech be conserved;
Restocking areas must be fenced against grazing;
Seed planting of conifers be made in blank places;
Cutting be done only in winter;
Use of wooden fences forbidden because of the threatened fuel famine (in 1762 observe!);
The villagers ordered to plant willow and alder along their streams;
Only invalids allowed to keep goats by grace of a medical certificate.

At that time one-third of the land was without timber and regeneration failed continuously because of mice, drought, insects, late frosts, etc. The annual production between 1762 and 1784 was one-eighth of a cord an acre, which shows how extremely decrepit these forests must have been.

Today the pineries of Ysenburg are among the finest and yield about the highest net revenue of any in the Rhine valley. The method used to secure regeneration is totally unlike that employed at Eberstadt and yet the type of soil seems about the same. When the pines are about 80 years old and about 10 inches in diameter, cuttings (seed cuttings and preparatory cuttings) are made in such a way as to open up the crown. There results a luxuriant natural regeneration which indicates that there must be more fertility present than in the soil of the Eberstadt pineries. When this regeneration

underneath the old stand is well established a heavy, final cut is made, leaving only a few trees to the acre to run through the next rotation as " veterans." The regeneration at this time is particularly thick, estimated to consist of fully 30,000 young trees to the acre and forming almost impenetrable thickets. In the resulting struggle among these 30,000 seedlings for dominance, clean and slender boles result. In taking out the final cut, naturally considerable damage is done to the young stand, but it is surprising how quickly these gaps close up even where no planting is done to " doctor " them up. The German forester dislikes to see a vacant patch of ground in the woods and usually plants something there immediately, although in many cases it is unnecessary and the results of his planting may be choked to death by the rapidity of the growth of the surrounding forest.

Conditions sometimes get the best of even the German forester, for in some compartments either too much delay has been exercised in making the final cut or the regeneration came faster than was expected, for it is so high and dense that irreparable damage will result when the final cut is made. Young trees can stand much abuse, but not when they are 15 feet tall. The last cut before the final one leaves about 75 fine standards to the acre, so that the regeneration takes place by no means under conditions that could be called " open."

All compartments, however, of the Ysenburg range are not so fine as the ones described above and which happen to be the ones nearest to the station. Some compartments are very poor and the pines are porcupinelike and scattered, having suffered from unusually sterile soil, mice, grubs, and other enemies. The white pine, where used under these conditions, seems to be making a better showing than the Scotch pine, but the expense of replacing the Scotch pine by white pine is high and out of keeping with any results that will be obtained for a long time to come.

A particular compartment at Ysenburg has been given over for many years to the experiment upon Borgrave's method of thinning. Thinnings, properly speaking, are for the purpose of reducing the investment or for the improvement of the remaining stand, and if a regeneration results it is merely incidental. Seed cuttings and preparatory cuttings (often miscalled thinnings in the United States) are for the purpose of regeneration, absolutely and only, and are not properly to be called thinnings, but cuttings.

Borgrave would take out one-fourth of the volume in one-seventh

of the trees every ten years. By this means he would reduce the investment and extend the rotation. The obvious advantages are: the reduction of the investment; greater remunerativeness of the cuttings; the rotation is extended perhaps 200 years; sylvicultural charges are reduced to a minimum; the smaller trees left are cleanest and will produce constantly better and better logs.

On the other hand is the fact that he takes the trees nearest the saw-log size and which will have the greatest price increment in the next few years. He cuts away the money makers, for these large trees (one-seventh of the total number) will furnish 90 per cent of the increment if left. If gaps result, some of the possible increment of the next largest trees will escape, weeds will result and the soil run wild.

Under conditions as they existed in Germany a few years ago, his method had, from a financial standpoint, much to recommend it, and it happens that at Ysenburg even now the difference between the price of saw logs and mine props is not very great. As the Scotch pine, however, sold at an average of $6 a thousand twenty years ago and sells for $14 today (on the stump), few German foresters are anxious to reduce their investment, so that Borgrave's system, pure and simple, as is being carried out here to its logical end as a matter of experiment, is not apt to be seen elsewhere, although the influence of his reasoning is frequently to be noted in the system of management practised in many places.

Another small compartment of the Ysenburg range shows that the German forester, like all of us, sometimes makes sad mistakes. Oak and Scotch pine in alternating rows, fully 5 feet apart, were planted by the "Tongya"[1] method 35 years ago. They wanted oak, and the pine was meant to be merely an usher growth to protect the oak against the frost, which is bad here (the frost level being 9 to 10 feet above the level of the soil), and expected to cut out the pine as the oak gained a position of independence. Today the oaks are nearly gone, having been choked out by the pine in spite of attempts to favor the oak by lopping off many of the pines. As they are 10 feet apart, they look today like a thicket of Appalachian scrub pine.

The oberförster has also been troubled severely in some compartments by the work of the cutworm upon young plantations, but he

[1] *Tongya:* a term introduced by Schlich, indicating the cultivation of potatoes, beans etc., between the rows of young trees for two or three seasons to aid the growth of the trees and help offset the expense of planting and weeding.

Plate 2

A primeval oak on the Mittledick range near Ysenburg, which measures 52 inches in diameter 6 feet above the ground

Plate 3

Advanced growth of beech artificially induced under Scotch pine in the city forest of Darmstadt

Plate 4

Beech seedlings under Scotch pine at Mittledick. Following a good seed year of the beech, the ground was broken up here and sown thickly to beech seeds, which had been gathered on another part of the range.

noticed that this damage was always slight, for some unknown reason, in the vicinity of mature stands. He has largely obliterated that damage by making his cuttings in strips from 75 to 100 feet in width, leaving stands more or less mature upon either side, until the planted strip has attained a safe size. These strips, in various stages of development, present a curious appearance, and they are of course on soils that will not yield the luxuriant natural regeneration that obtains in the compartments nearest the Ysenburg station. Under such impoverished soil conditions, the oberförester may eventually be forced to adopt the expensive method in vogue at Eberstadt.

At Ysenburg is one of the few, if not the only one, of the strictly forest railroads in Germany. It consists of a narrow gauge line running from Ysenburg down through the Mitteldick range to the river Main. Its poor success is evidence of the uselessness of railroad transportation in a large range where the woods products go out in many different directions and which is traversed by excellent stone roads, as are the Ysenburg and Mitteldick ranges which adjoin.

3 MITTELDICK FORESTS

The Mitteldick range adjoins the Ysenburg ranges on the west and was, originally, under the dominion of the princes of Ysenburg, but is now a state (Hesse-Darmstadt) forest. The Scotch pine stands here are similar in every respect to those described on the Ysenburg range. The object of particular interest on this range are the oak stands; remnants of the primeval Rhine valley forests. They are maintained today in the form of "shelterwood group types of regeneration." The groups are particularly dense and thicketlike, and form an interesting sight, always highest in the middle, and spreading toward each other as the seed years and soil conditions allow. Forstmeister Hillerich aims to join these groups at a time when he shall have finished cutting out the remaining 15 to 20 old oaks for each acre of the original stand. All stages are to be seen from the beginning of tiny groups in the openings of the medium aged oak forests to large masses of groups now fully united and from which the last of the old oaks have been removed.

Where the shelterwood group method of regeneration has not been a success, and it is not always a success because of unfavorable soil conditions in some places, the Forstmeister has resorted to other means of securing an oak stand. One large strip was planted, 16

years ago, to oak acorns, very densely; and it appears that this method is particularly successful just here, and would seem to be preferable and cheaper than waiting for the uncertain and slow shelterwood method.

On other compartments of the Mitteldick range the growth of oak has been induced under pine standards, about 120 years old. The pines are fine, but the oak is generally crooked in spite of its relative density. It is planned gradually to remove the pines, which number about 20 to the acre, and see if the oak improves in quality.

The German forester as a rule loves beech, which is in youth a shade-loving species, and one finds a great variety of methods by which the beech is utilized in German sylviculture. The German forester calls the beech the "mother of the soil," possibly because it forms an alkaline litter instead of an acid litter as results from the fall of the oak foliage. At Mitteldick is to be seen several methods of handling beech growth, two of which are rather noteworthy. In certain compartments an abundance of beech seeds have been sown in drills or furrows beneath rather dense stands of Scotch pine about 60 years old. The result is rather startling to the American accustomed only to seeing our native forests of pine or spruce with only a scanty undergrowth. A dense thicket of beech springs up, almost impenetrable in places, and wherever gaps occur in the forest crown overhead or where cuttings are made the beech rapidly assumes the dominant position, but under the thicker pines it remains in suppression for many years, in this respect not unlike the spruce. A similar management of beech is to be seen in the Darmstadt city forests (plate 3) and in other ranges of the Rhine valley.

Another compartment of mixed oak, beech, hornbeam, and other hardwoods had been likewise underplanted with beech seeds in furrows, and after an interval of about three years, at which time I saw the compartment under a light coat of snow (plate 4), it looked not unlike a vast collection of nursery beds containing tiny beeches all about of a size. Such operations must naturally follow good seed years.

4 THE FRANKFURT TOWN FORESTS

The Frankfurt town forests adjoin the Ysenburg and Mitteldick ranges on the north and are therefore most easily reached from Ysenburg station. The line separating these ranges is also the boundary here between Prussia and Hesse-Darmstadt, so that the effects of radically different forest administrations can be seen on

Plate 5

Products (ties, slabs, cordwood and fagots) of thinning operations in the pineries of the Rhine valley

Plate 6

Stand of American white pine in the Frankfurt town forest, containing 35,000 board feet to the acre, 60 years old. Originally planted with oak and spruce. Only a few spruce are left and no oak. As a result, the white pine has not produced very clean timber, but the stand is valuable for the seed produced from it.

these adjoining ranges. Like the former ranges, most of the Frankfurt range lies in the frost dells of the Rhine valley, but within short distances there is much diversity in the quality of the soil, and in consequence a corresponding diversity of stands.

Along a small stream close to the suburban villa colony of Neu-Ysenburg is a stand of hardwoods which contains some fine alders up to 2 feet in diameter, not very straight but about the best seen anywhere in Germany. This stand also contains some excellent maple, ash, basswood, hornbeam, oak and beech. The hornbeam logs sell, in the woods, on the ground, for $35 a thousand feet, board measure, and are used in the manufacture of waterwheel cogs. The oak, which is here of fair quality, brings $31 a thousand feet for ties and veneers. The best veneer logs of oak in this compartment were about 24 inches in diameter and contained about 350 board feet, on the average, and sold at auction there in the woods for about $82 each.

A mixed hardwood forest of this type is the best place to see the attention to detail and order which the German forester brings to his operations (plate 5). The firewood resulting from the trunks and limbs of the trees unsuitable for timber, is piled into neat cubic meter piles of split oak, split maple, split alder, round oak, round maple, etc. The smaller and more crooked branchwood and rootwood of each species is also piled separately, and for each and every one of these "grades" of firewood the forest administration receives a different price. The small limbs and twigs are also gathered up and tied into bundles which are sold for a small sum, but apparently not at a profit. That genius is an infinite capacity for taking pains finds here a visible demonstration in forestry.

The Frankfurt town forests also contain an interesting stand of American white pine (plate 6), about 60 years old. It was originally made with alternating rows of spruce and oak. The oak is now nowhere to be seen, and the spruce has survived only in part. The white pine having dominated the situation from the start is very branchy and unfit for a high grade of lumber, and yet the revenue from this stand is very large, but from the sale of cones to seed establishments rather than from timber. The pines number about 150 to the acre, and spruce less than half as many, out of an original 1500 pines and spruce to the acre. The total sectional area of the white pine alone is 153.6 square feet, which with a form height of 150 means a stand of 35,000 board feet to the acre. This is far from being the best stand of white pine in this part of

Germany but it is of particular interest as showing the results of mistaken ideas in regard to the management of white pine with spruce and oak, mistakes which are not being repeated in later plantation of white pine throughout this part of Germany. The yield of cones for seeds alone saves the plantation from being a complete failure and from having been removed long ago.

Several compartments of the Frankfurt woods still maintain the stands of beech with oak and other hardwoods which comprised the primeval timber of this region. The beech is about 120 years old and about the best, considering the large acreage devoted to it, to be seen anywhere in the Rhine valley. In the depressions (frost dells) alone are there any signs that the beech is not vigorous, and there the abundance of hornbeam makes up for it. Underlying limestone, close to the surface, probably accounts to a large extent for the good growth of these hardwoods upon a surface soil which seems unusually sterile. The German forester judges the fertility of the soil largely by the relative growth of wild grasses thereon, and in most cases that appears to be an excellent index of the quality of the soil.

Not the least interesting feature of the Frankfurt forests is the existence here of the oldest artificially planted stand of Scotch pine in Germany. This stand is now a little over 200 years old and looks wonderfully fine. There are about 60 trees to the acre, averaging over 20 inches in diameter, and some are as thick as 36 inches, breast high. A single tree recently cut, contained 4100 board feet of lumber. In 1876 a violent wind storm took down many of the trees and since then the previously suppressed beech and hornbeam have made a vigorous growth which shows that nature without aid will not reproduce the Scotch pine where it is not native. Only by carefully opening up the crowns, as practised on the Ysenburg range, can a pine regeneration be induced. A sudden and large opening of the crowns brings on the hardwoods again as in the primeval type. The old pines, as a result of the storm, all lean toward the northeast. The stand contains from 25,000 to 30,000 feet an acre, which is good considering the relatively few trees per acre and the large quantity which has been removed in the past according to the records of this department. The remaining stand will produce lumber of an exceptionally high grade. From the logs upon the ground it was impossible to determine their form height, but it certainly exceeded 200.

From observations previously noted in connection with oak planted

Plate 7

Lindenfels in the Odenwald, showing the complete utilization of all of the land. Lindenfels is situated upon an elbow of the hills some 500 feet above the main valley so that this view does not indicate the extreme hilliness of the region.

Plate 8

A stand of spruce on the "Throm," one of the high summits of the Odenwald north of the little town of Wald-Michelbach

with pine on the Ysenburg range and in the Frankfurt forests one might suppose that oak is usually a failure here, but such is not the case. Above the frost dells it succeeds very well, and indeed, the primeval forests of this region contained some of the largest and finest oaks of the world, a few of which are still to be seen on the Mittledick range. The Frankfurt forest contains a plantation of oak, nearly 100 years old, with subservient natural undergrowth of beech and hornbeam which looks as good as any of the natural regeneration of oak seen in the Spessarts, so famous for its oaks. Here in the Rhine valley, however, the beech shows a tendency to become the dominant tree if not held in check. This stand of oak contains, including the beech, some of which are of merchantable size, 19,000 board feet to the acre.

The annual net revenue of the Frankfurt town forests is $16 a hectare, or about $6.50 an acre, in spite of the fact that many a sacrifice is made for landscape and recreation purposes.

5 THE ODENWALD

The Odenwald (plate 7) is a hilly or semimountainous region of considerable extent lying east of the Rhine valley and north of the Neckar river and Heidelberg. The underlying formation is granite at lower elevations and chiefly sandstone at the highest elevations, a factor which, taken in connection with the absence of limestone, has played a very important part in the development of forestry in some parts of the Odenwald.

The deep, broad valleys of the Odenwald are devoted largely to agriculture, while the steepest slopes and higher summits are given over to forests. The primeval growth of this region was entirely hardwoods, but the region is rapidly changing in aspect as the extensive planting of conifers (spruce, fir and pine) which has been going on for the past hundred years begins to dominate the landscape (plate 8).

Out of the many interesting ranges in the Odenwald it would be hard to pick any one which is typical of the whole region. Each range, in which some particular policy has been carried out for a long term of years, presents features peculiarly different from every other range.

The policy of the state has been to acquire by purchase the small woodlands belonging to the farmers. The latter, however, finding the raising of Christmas trees remunerative, are not anxious to sell, and it is quite curious that within the state of Hesse, which

includes the northern part of the Odenwald, the government is buying woodlands at a minimum price of $360 an acre, while in the adjoining grand duchy of Baden, where the state is not so eager to acquire private holdings, there is paid not over $120 an acre for woodlands, under otherwise equal conditions.

The growth of white pine is particularly good everywhere in the Odenwald, and on the better classes of soil and on northern slopes some very successful results have been obtained with hickory, black walnut, red oak and other foreign hardwoods. Beautiful pole-woods of silver fir and spruce are seen everywhere and Scotch pine is not uncommon. On good soils, however, it is usually the policy to make every effort to retain and build up the mixed hardwood stands of oak, ash, maple, basswood and cherry.

One of the interesting ranges of the Odenwald forests is that of Affoltenbach, under the administration of Forstmeister Strack, consisting of about 8000 acres, one-half being state forests, and the other half communal forests, owned by ten different towns and hamlets. That of Affoltenbach contains about 1000 acres, and the sale of material is conducted by the town council or by the Bürgermeister.

By 1870 the price of oak tan bark had reached such a high figure that many towns were tempted to convert their forests into coppice, which yielded large returns in short rotations. By 1885 the price of oak tan bark had declined to an unprofitable figure and these towns were confronted with the problem of reconverting their practically valueless coppice into "seed" or "high forests." The poverty of the soil and the aggressive growth of heather (Calluna vulgaris) in the coppice forests have made this a very difficult and slow as well as expensive process. Here can be seen as nowhere else the relative ability of different tree species to conquer the heather, for they have tried almost every conceivable combination to overcome its aggressive growth.

Prior to the oak coppice forests, heather was not a serious menace in the forests of this range, and the factors which have brought about its domination of the soil, while they could not have been anticipated at that time, are now well enough understood. The best explanation of this ecological condition which we have in English is F. V. Coville's investigations on upland heather soil. He found that oak leaves do not only decay very slightly but that they are decidedly acid in reaction even when two or three years old. In these forests of the Affoltenbach range the introduction of the coppice system permitted much sunlight to reach the litter upon the

Plate 9

Redwood (Sequoia washingtoniana) and Douglas fir (Pseudotsuga taxifolia) in the arboretum of Count von Bergheim at Weinheim in northern Baden

ground, which retarded more than ever the natural course of decay with the result that an acid litter developed which favored the enormous development of heather which is now troubling the foresters in many places. The absence of any limestone in the rock formations of the region, which might serve as a source of possible neutralization of the acid litter, has produced conditions upon the introduction of the oak coppice system not unlike the upland heather character of much of the southern Appalachian soils.

Spruce is the species most desired just now, by reason of its comparatively high value and wide range of utilization, but it has a slow initial growth and nowhere has it conquered the heather unaided by man, to any marked degree. In some places where the heather is not too dense the spruce is slowly forging ahead, but the process is slow and thus expensive, and these tracts will yield no returns for a long time to come. On a small experimental tract of one-fourth acre, with spruce 15 years old, and their tops, or some of them, barely showing above the dense mat of heather, the oberförster has grubbed out the stems and roots of the heather, obtaining the enormous quantity of a dozen large loads of the dried heather. This was done to see if it would give the spruce a chance to get well ahead of the heather before it completely dominates the soil again. Shade is fatal to the heather but it is difficult for any species unaided to reach a height where it will overshade the heather.

White pine alone shows any marked ability to overcome the heather by its rapid height growth and the heavy humus which it speedily forms and which seems to choke the heather out of existence without much aid from the foresters in charge. Even where there is left for the heather under the white pine some overhead light the thin layer of needles cast over the heather seems fatal to its growth, and it is soon replaced by a smooth carpet of pine needles. On the other hand the white pine will not yield any considerable returns by thinnings and is considered too weak for poles and mine props and too soft for firewood. In fact these are probably the principal reasons why white pine is not more extensively planted in many other places abroad. In the case of the Affoltenbach range the foresters in charge plan to get rid of the heather by means of the white pine and then to replace that by more desirable species.

In the small hamlets of the vicinity some characteristic home industries which depend upon the forests are to be observed. Handmade split oak shingles are still used to a large extent for roofs and

sides of houses. The villager buys his oak logs from the state or communal forest, paying about $50 a thousand feet for good grade material. He dissects the logs into suitable lengths and then splits them by hand with a sharp, straight blade to which is attached at right angles a wooden handle. The work is facilitated by the use of a heavy beech mallet. The villager engaged in this occupation sells the shingles for $8.10 a thousand shingles 3 by 10 inches, and can cut about 700 shingles a day. It is claimed by them that they can cut 4500 shingles from 36 cubic feet of oak, which would be equivalent to 1000 shingles from every 50 feet board measure. One may well doubt this unless the material is uniformly perfect, which did not seem to be always the case. Five hundred shingles from every 50 feet board measure seems a better estimate, but even at this they make excellent returns if they are able to cut 700 shingles a day.

Another home industry is the manufacture of split hoops. Thinnings of oak, beech, hazel etc., three-fourths of an inch to an inch in diameter and 6 feet long, are used, being purchased by the villager from the forest for about $2.25 a cord, the price varying slightly according to the species and quality. The strips are steamed and then split into halves by the use of a draw shave, tied into bundles containing 600 linear feet each and sold for an average price of 50 cents each. They are used very largely for boxes and slack cooperage. The refuse and cut ends supply the family with fuel. The manufacture of these hoops, while on a small scale, is profitable as a side issue to these agricultural people.

A visit to the Odenwald region is scarcely complete without seeing the arboretum on the private estate of the Count von Bergheim at Weinheim, the northernmost town of Baden. The climate of most of Europe, and in particular that of the Rhine valley, seems to be especially adapted to the growth of the Pacific coast conifers. Many forest gardens and botanic gardens of Europe contain a large variety of trees but none of them have so many foreign trees in large sized plantations as in the estate of Count von Bergheim. These steep hillsides were at one time devoted largely to vineyards, but about 60 years ago the cultivation of the grape was considered a failure here, either from changes in the climate or soil, so that the vineyards were abandoned and the estate planted to trees, in small compartments from one-eighth to one-fourth of an acre each. On each compartment was planted a different species, and in some cases a mixture was used, as, for example, with the Sequoia washingtoniana (plate 9)

was planted Douglas fir (Pseudotsuga taxifolia). The largest of the redwoods are now 30 inches in diameter and bear an abundance of cones nearly every year. According to information from an employee of Conrad Apple's seed firm in Darmstadt, the seeds from these redwoods possess less than 4 per cent of germination. As producers of timber, most of the American conifers in cultivation on this estate must be regarded as failures, not because of slow growth, for most of them have made phenomenal growth in the past 60 years, but because they were planted too far apart and are covered with branches nearly to the ground in addition to possessing more than the usual taper at the base.

On this estate are to be seen some fine plantations which, aside from the faults noted above, give an excellent idea of the wide range of species which can be grown in the climate of the Rhine valley. They include:

Pinus monticola *Dougl.*
" lambertiana *Dougl.*
" ponderosa *Laws.*
" jeffreyi "*Ore. Com.*"
" austriaca *Hőss.*
Picea sitchensis (*Bong.*) *Trautv. & Mayer*
Abies concolor (*Gord.*) *Parry*
" cephalonica *Lond.*
" pinsapo *Boiss.*
Tsuga heterophylla (*Raf.*) *Sarg.*
Pseudotsuga taxifolia (*Lam.*) *Britt.*
Sequoia washingtoniana (*Winsl.*) *Sudw.*
Libocedrus decurrens *Torr.*
Thuya plicata *Don*
Chamaecyparis lawsoniana (*Murr.*) *Parl.*
" nootkatensis (*Lamb.*) *Spach.*
Tumion californicum (*Torr.*) *Greene*

Many other trees are represented by groups or scattered individuals. While most of the species are American, there is a good representation of oriental and Japanese conifers. The coast redwood (Sequoia sempervirens (Lamb.) Endl.) would hardly be expected to succeed in Germany, in spite of which fact there is a clump of half a dozen trees in a sheltered situation at Weinheim which might be said to be existing, as they show little vigor and some have died. The largest one has produced a few cones.

6 TRIPPSTATT IN THE PALATINATE

The Palatinate is a beautiful rolling country west of Mannheim and the Rhine and belongs to Bavaria. The eastern portion is

chiefly agricultural while the western portions are semimountainous and densely wooded. Trippstatt is reached by carriage from Kaiserslautern, which in turn is about two hours train ride west from Worms.

At Trippstatt the underlying rock is soft, red sandstone of Triassic origin, and the soil, except the alluvial flats, is of a reddish color and contains a large amount of clay. The region was originally covered with a hardwood forest and the pine, spruce, fir and larch, now perfectly at home and very abundant, are all introductions.

The Trippstatt range consists of about 10,000 acres, half of which is under the direct management of the forstmeister and the other half under the management of the forstassessor. Many years ago this range was the private property of the Hache family, which constituted one of the countless little principalities similar to the princes of Ysenburg. The highways in the Palatinate are built and maintained by the forest department, a fact which doubtless results in a serious lowering of the net revenues. The roads around Trippstatt were constructed by the Tellfort method and the complete cost was about $5000 a mile. Having charge of the roadways, the forest department secures some advantages in return by placing many of their little tree nurseries along the roads. A beautiful valley, traversed by a winding macadam road, leads from Kaiserslautern up to Trippstatt, and along this road there occurred a few years ago one of the few forest fires of recent years. Some fifteen acres were burned over and it is said that only a change of wind prevented the fire from doing greater damage. The growth was beech with clumps of spruce. Curiously enough, it appears as if many of the clumps of spruce escaped destruction because they had conserved enough moisture in the soil to check the intensity of the ground fire, while the beech were entirely killed.

On the summits of the hills the soil is very poor. Here are some quite interesting stands of beech fully 100 years old, the trees small, crooked and far apart, while close by are artificial stands of white pine 25 years old, in rows, already with an average diameter of 6 inches and truly fine in appearance. In fact, the excellent appearance of the coniferous stands here, whether pure or mixed, of even or of uneven age, in contrast to the native growth is most surprising.

Trippstatt, however, has other points of greater interest to the forester than these old stands of beech. There is located here a Scotch pine experimental garden, where were raised from seed, in the same nursery, planted on the same day, and transferred to

the garden and outplanted in rows the same distance apart and on uniform soil, Scotch pine from Hungarian seed, French seed, Belgian seed, Finnish seed and native Pfalzian seed. The experiment is now twelve years old and may be briefly summarized as follows:

The Hungarian pines show many failures, a heavy death rate, many of wolfy, unsymmetrical and uneven rate of growth, frequent loss of top shoots, not uniform, unhealthy in color, averaging slightly over 3 feet in height.

The French pines are darker in color and more healthy in appearance, but show, nevertheless, many failures and a strong inclination to grow wolfy and unsymmetrical. They average about 5 feet in height.

The Belgian pines form a stand particularly dense and in which there are practically no failures. The trees are now 11 to 13 feet tall and have fully conquered the soil. A carpet of needles has begun to form beneath them and they are self-pruning their lower branches. This stand is the darkest green of all.

The Pfalzian pines, from seed gathered nearby, average about 11 or 12 feet in height, with very little death rate, are dark green and healthy, but owing to the vigor of growth there has been a little snowbreak. They seem to differ in no important particular from the Belgian trees unless they are a little more symmetrical and slightly shorter.

The Finnish pines are of a uniform light yellow color, averaging about 4 feet in height with considerable death rate. The needles are short and the whole appearance of the stand indicates slow yet uniform and symmetrical growth, which are the features to be expected from pines coming from a region with so short a growing season as Finland.

The results of this interesting experiment are already forecasted, and they show that seed for forest planting should come from a source with a climate, at least, similar to that in which the seeds are to be grown, especially if it be a species with as wide a climatic range as the Scotch pine.

Future visitors to this range will also be interested in the experiments recently started with seed from (1) crooked, (2) wolfy, (3) symmetrical mature, and (4) young trees, to determine whether the parentage has any influence on the progeny in the transmission of such characters as crookedness, unsymmetrical growth, vigor etc.

Fully as interesting as these experiments, especially to the American visitor, is the famous Hacke stand of white pine 120 years

old, the first made in Germany for forest purposes. These stands are upon abandoned pastures. The Baron von Hacke was an officer in the Hessian regiments under George III, and after the American Revolution returned to his impoverished soil bringing with him a quantity of white pine seed. The trees of the original stand average today 32 inches in diameter, breast high, and finer white pines are not now often seen in our own land. Up to 30 years ago the abundant regeneration was not preserved, but since that time, under a different forest management, the natural stands have been preserved and look as thrifty as those so frequently seen upon abandoned fields in New England.

At the head of a picturesque ravine near the village of Trippstatt, the forestry associations of the Palatinate, Alsace, and Lorraine have erected a tablet commemorating the introduction of white pine by Baron von Hacke. From a window of the Hacke baronial mansion, a fine old standstone structure, there is obtained a beautiful view overlooking a small valley in which there were at one time iron mines and furnaces and above which looms some old castle ruins dating back into the middle ages. With this view before him, Schiller is said to have composed the poem, "Der Gang nach dem Eisenhammer," in 1797, upon the occasion of a visit. The old baronial mansion is now devoted to the uses of a forest ranger school where boys are educated along general and technical lines beginning at the age of 14 years. For its purpose it is well equipped, containing excellent mineral and geological collections, wood specimens, fungi, stuffed birds, insects etc.

The following table shows the prices which were received for cut timber on the ground in the woods at Trippstatt. It will be noticed that white pine here, as elsewhere in Germany, commands a high price only when the logs will produce a very high grade of lumber. For mine props, pulp, poles and firewood the white pine is not highly esteemed.

GRADES	1	2	3	4	SPECIES
Price in dollars per 1000 feet b. m.	25	20	15	.....	Scotch pine
	27	22	19	11	Spruce
	26	20	17	11	Fir
	30	23	19	12	Larch
	45	26	16	9	White pine
Diameter in inches...	12 and up	8 to 12	6 to 8	5 to 6	

Plate 10

The Saxony Forest Academy at Tharandt

7 THE THARANDT FOREST ACADEMY

Tharandt is about 30 minutes ride on the cars from the central station of Dresden and well repays a visit by one interested in forestry education. The school is purely technical and is not attached to any university, but is under the direction of the forest department of Saxony. The equipment is excellent in every way and especially fine is the instruction and equipment of the departments of surveying and sylviculture. Well equipped also are the physical and chemical laboratories. The history of the Tharandt school is inseparably associated with the name of Heinrich Cotta, who died here in 1844 and is buried in the forest garden above the valley surrounded by 80 oaks planted there by his pupils prior to his death.

The forest garden at Tharandt is a sort of arboretum and is interesting on account of the fairly large number of foreign trees of large size which it contains. It is not a "made" or refilled garden and has in consequence several varieties of soil and exposure. For the most part the specimens are well labeled, but occasionally one sees some errors which are not unexpected in a large garden with a small staff and a head gardener better trained in the care and raising of trees than in their nomenclature. The Garden also contains a small museum filled with various dendrological curiosities. The history of the garden dates back to the beginning of the nineteenth century, but most of the American and Asiatic species are of comparatively recent introduction.

Adjacent to the forest garden are several hundred acres of forest under the direction of the school and in which the students find their practical demonstrations. The original working plans were made by Cotta in 1811, who laid out the compartment lines in rectangles, not a very convenient method for such a hilly range. More recently there has been a reestablishment of roads and lines which meander according to the topography so as to facilitate the separation of the cove forests from the plateau forests and to facilitate forest transportation. The plateau forest of the school range consists almost entirely of spruce, the best stands of which are about 110 years old and contain some 105 cords to the acre.

Among certain introduced species for forest planting they have tried Douglas fir mixed with spruce. A 25 year old stand of this sort shows considerable injury to the fir from heavy snow.

8 SCHWARZENBERG IN SAXONY AND VICINITY

The town of Schwarzenberg, like many of the towns in the more hilly or semimountainous parts of Saxony on the northern edge of the Erzgebirge, has shown a wonderful industrial development within very recent years and a consequent increase in population. The city of Lauter increased in population from 5000 to 15,000 in fifteen years.

The forest range about Lauter is under the charge of Oberförster Dittmann. Another home industry, quite as interesting as those seen in the Odenwald, is carried on to a large extent in this vicinity. This is the making of split spruce baskets. The only tool used is a strong-handled knife with which the villager splits the wood with the medullary rays, for strong pieces, or with the annual rings, for finer pieces. The smallness and uniformity with which spruce can be split with a sharp knife is truly remarkable. The bottom of the basket is first made out of thin strips and then the sides are constructed. At the top are used strips specially prepared for bending by drawing them between a wheel and a round billet of wood, in one direction only. The baskets are very light and measure about 4 feet by 4 feet by 3 feet deep, and sell for 18 to 25 cents each. They eventually find their way for the most part to dealers who ship in them straw hats, flowers, plants etc. The children of the family are taught this trade from earliest youth, but it appears that the main profit in this as in the beautiful lace made by the women of this region goes to the dealer or middleman. The spruce logs used in the home basket industry cost, delivered to the house, about $38 a thousand feet board measure. Different families produce baskets of different sizes and quality, some of which sell as low as 3 cents.

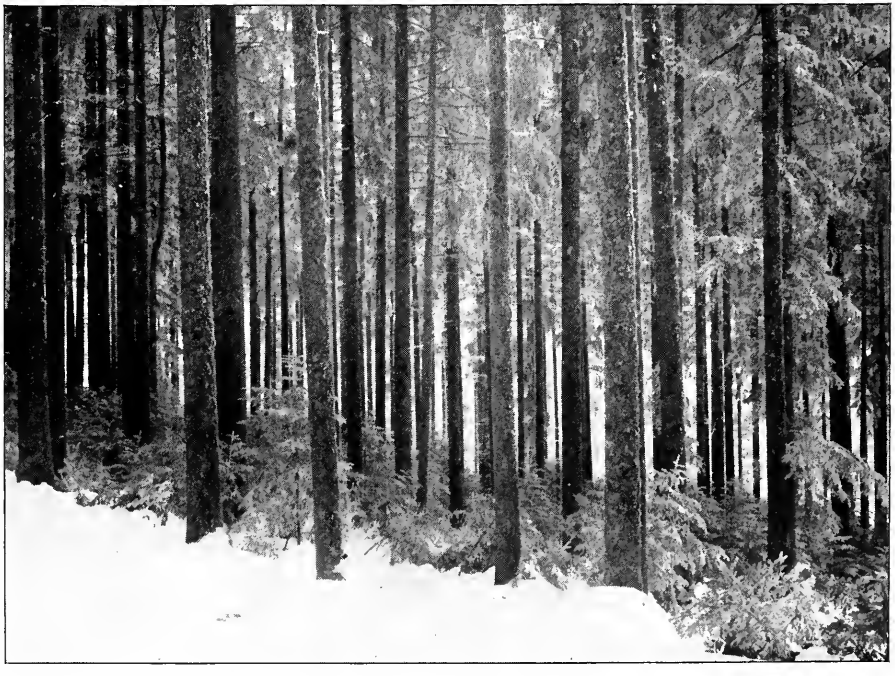
The city of Lauter owns about 6000 acres of land upon which the growing stock of timber has increased from 54,000 cords in 1847 on one district to over 100,000 cords today. The other district of the city forests shows even a greater increase.

On the hills above Lauter is the forest known as "Burkhardtswald," facing the factories at Aue and Lauter. The rapid development of the industries at these places and especially the metal-ware industry, has played sad havoc in these woodlands. The former owners (city of Zwickau) took no protective measures but brought suit against the state of Saxony, which is part owner of certain dye and metal-ware works in the valley below and which was held responsible in a large measure for the destruction of the forests

Plate 11

A Black Forest stand of spruce which contains upward of 60,000 board feet to the acre. No preparatory cuts have been made as yet which accounts for the entire absence of undergrowth.

Plate 12



A Black Forest stand of spruce showing the luxuriant advanced growth following the preparatory cuts made some ten years previously. The stand is now ready to be cut clean and the next rotation of trees is already well started.

by fumes and gases issuing from their chimneys. The state of Saxony, in order to avoid further litigation, bought the tract in 1900 for $125 an acre.

All sorts of experiments have been tried here to secure a forest growth which will not be killed by the fumes. The spruce is suffering badly all around here from the work of a weevil, so much so, that in one fine pole-wood seven out of every ten trees had been removed for this cause alone. Of mixed plantations of conifers and hardwoods it appears that here the native birch (Betula pendula) is most resistant to the fumes, that Japanese larch does better than the German larch, that Scotch pine and Jack pine are more resistant than white pine.

The Antonsthal range, for nearly a quarter of a century in charge of Oberförster Gleier, is reached by a short train ride from Schwarzenberg. Like most of the Saxon Erzgebirge, the slopes are steep and the soil, except in the bottoms, thin and sterile. It is rare to find any regeneration of spruce or fir from self-sown seeds, although considerable effort has been made to bring about that result. Replanting with 3 year old spruce is the common practice. The spruce are raised in shifting nurseries close to where they will be outplanted. Transplanting of the spruce before outplanting is apparently not practised.

The forests of this region reflect the character of the recent economic development of this part of Saxony. The abundant water power has encouraged the development of paper pulp mills, with a corresponding demand for spruce pulp wood. The result has been a rapid transformation of the old stands of large sized spruce and fir into spruce forests of short rotations, of 35 to 45 years. This means a smaller investment and a correspondingly higher net revenue. The pulp mills, of which there are several in the vicinity of Antonsthal, derive their supply of pulp wood from the home range or from Bohemia by rail.

The Breitenbrunn range, in charge of Oberförster Thomas, adjoins the Antonsthal range and presents about the same features. Spruce is the prevalent species everywhere except upon a few more fertile spots where ash, maple and beech are planted. In 1908 this range was visited by a particularly severe wind and snow storm so that 30,000 cubic meters of timber were broken down by the snow and wind. As a consequence the net revenue on this range for that year was the highest in Saxony, or 5.1 per cent.

9 THE BLACK FOREST

I dare say that no one who has ever visited the region of the Black Forest fails to look back upon that visit as one of the milestones upon life's journey. A semimountainous region extending from the Neckar at Heidelberg to the Swiss border and from the valley of the Rhine across Baden and most of Württemberg, for the most part covered with forests of spruce or fir and with small farms and villages in the valleys, with its fine roads reaching to every portion of the forest, presents a picture of beauty that does not fade quickly from the mind.

In the days of the primeval Black Forest the conditions were somewhat like those prevailing on the Pacific coast 20 years ago, as regards lumbering operations. The timber most accessible was cut first. The operations were reckless, timber rights were sold cheaply or were given away. The logging camps were established where there was a little tillable soil, and from such beginnings have come the numerous little villages of the Black Forest. The men worked in the woods, and during periods when woods work was slack they cultivated their little tracts of ground, built roads, wove baskets and carved wood. The government received, on the average, only 6 cents a log in those days. No working plans existed, as all the timber was mature; but with the development of railroads and new markets and the enlargement of the market from a local one to a far-reaching one, the value of the Black Forest rose by leaps and bounds in spite of the rapid cutting away of the primeval forest.

The Black Forest covers 500,000 acres in Baden and 600,000 acres in Württemberg. Much of it is now private (such as the enormous holdings of the princes of Fürstenberg), communal, state and stock companies.

The early method of marketing the timber was to raft the logs down the streams to Holland or intermediate markets, but prior to 1718 the existence of many little principalities through which the logs must pass to a market made it expensive or unremunerative in spite of the low cost of the stumpage. After 1718, by means of a treaty between the various small states, the rafting of logs became possible upon a large scale.

No good records exist of the forest conditions of the Black Forest prior to 1758, when the region is said to have contained more than 80,000 feet of timber an acre, and many trees contained as high as 28,000 board feet each.

The companies rafting logs to Holland in some cases acquired

Plate 13

Tower on the summit of Badener Höhe, one of the high subalpine points of the Black Forest. The native growth consists largely of Pinus montana.

Plate 14

A typical winter scene in the Black Forest, from the lower slopes of the Hornisgrunde, one of the highest points in this region. Severe storms are largely responsible for the failure of the spruce stands on some of these exposed subalpine summits.

Plate 15

Numerous "roads" which are rarely used except for the transportation of woods products and for winter sports, often serve at the same time as "compartment lines"

tracts of timber which they still hold and operate. That their early operations consisted in taking only the best is testified by Jägerschmidt who, in 1828, writes that the tracts over which they had logged contained still many fine trees over 1 foot in diameter and 100 feet tall. Only the very best trees were taken out in the same way that the early lumbering operations in this country were conducted.

The lowest and easiest slopes were logged first and hence today we find for the most part the best and oldest stands (second growth) closest to the streams and in the most accessible places, while at the higher altitudes and most inaccessible places where the good roads have only penetrated within the past 50 years we find the youngest stands, for it was here that the primeval growth was cut last.

Stumpage prices in the Black Forest have risen very rapidly, even recently. In the past 5 years from $13 to $17, and from $20 to $26 for the better stuff. Only since there has come to be a market for any and all products of the forest have working plans come to be a feature of Black Forest operations. Formerly the working plans were made for periods of 100 years, but with the increasing realization that conditions of market and transportation and demand change rapidly, these working plan periods have been made shorter and shorter, until plans for 10 year periods are considered quite sufficient in most places.

A working plan of a German forest is an interesting document and consists of:

a Inventory of values at hand (statement of facts); and includes timber, pasture, hunting rights, value of land, minerals, water power, mill property, roads, logs cut and on hand, nursery sites, agricultural land, etc.

b Boundaries, organization, means of logging, etc.

c Market and relative demand for the various products, local or foreign.

d Working plan (that is, changes of fact to be made or provided for). Herein is outlined the work to be carried out on the forest in the future.

What a working plan provides is of course largely governed by the owner's opinion. An optimistic owner will cut little; hence changes will be toward increasing the investment. A pessimistic owner will want heavy cuts, discarding all but what commands the highest price (as pulp wood in Saxony). In Saxony they did not rely on an increase in stumpage; in the Black Forest they did and

have accumulated timber capital. Again, Saxony's method has created their highest present values and they have the highest present returns on their invested capital (which is relatively small). In Saxony, neither the demand nor the price of large logs has increased. The rise has been greatest for the small material and hence Saxony has reaped and continues to reap today the highest returns, while the Black Forest has the highest value in forest capital with the smallest returns.

The larger logs are sawn into lumber at the mills, in or near the forest, while most of the other forest products, such as poles, mine props, railroad ties, Christmas trees and pulp wood are assembled at a railroad station for shipment to centers of consumption of such products. (Plate 16)

10 GRAMSCHATZ FOREST, BAVARIA

The Gramschatz district is situated in a great bend of the Main river in northern Bavaria, 15 kilometers north of Würzburg. There is a fine automobile road through the forest, over which during the summer there are run for the benefit of visitors automobile buses to a little inn known as the "Einseidel" in the heart of the woods.

The Gramschatz district is administered by Forstmeister Gleich, who has his headquarters at Thungen, to the west of the forest. The forest comprises two districts of about 5000 acres each. The eastern district, containing the best timber, is in charge of Assessor Friedrich.

The underlying rock is fresh limestone and cupar limestone, the disintegration of which results in a deep and fertile soil. In some of the quarries from which stone for the roads is taken are found large petrified shells, some of which have a diameter of 10 inches, while petrified mollusks and fishes are common in the rock of this section. The rich soil is responsible for the prosperous agricultural communities here. The 400 inhabitants of the village of Gramschatz are said to be very wealthy. The village, however, owns no timber land as do most other German villages, but is forced to obtain its supplies from the state forests. This may explain the high price of fuel wood, for which is being paid as high as $15 a cord in the woods.

In 1806 the Gramschatz forest was owned by the archbishop of Würzburg, who used it as a hunting park. Old ponds made for the deer to bathe in and ditches used for the drives are still to be seen here and there in the woods. The forest was formerly managed

Plate 16

Forest products (poles, mine props, ties, Christmas trees and logs) assembled at a railroad station in the Frankenwaldof northern Bavaria

as coppice under standards, the coppice being treated in rotations of 32 years, and consisting of hornbeam, basswood, birch, oak and beech. The white oaks and beech were the standards for the former coppice and there is still left an enormous number of these prime white oaks, which are being gradually cut.

The Gramschatz administration receives for its timber, prices ranging from $15 to $100 a cubic meter, the latter price for the best veneer oak. The gross receipts obtained at the auctions of timber aggregate over $60,000 a year for this range.

The coppice under standards system began in 1806, when the archbishop was deprived of his possessions, which were then made over to the "Reichsverweser." In 1814 the lands were turned over to the kingdom of Bavaria, which continued to cut down the coppice woods and to replace them by a high forest. The pole woods of beech, now over 90 years old, are particularly fine, excelling in straight trunks and rapid growth. The heavy mast years for oak which occurred in 1897 and in 1900 were taken advantage of for the planting of large areas to oak. There is probably nowhere in Germany, unless it be in the Spassart region famous for its oaks, a better second growth of oak than in the eastern part of the Gramschatz forest. The oak timber of the Gramschatz forests is but little inferior in quality to that of the more famed Spessarts, where several giants of the primeval forest still exist (plate 17).

The last working plan advanced has been a return to the coppice system. As a matter of fact, however, the coppice system here has been very much overdone and it is noteworthy that the management has agreed to reproduce hornbeam, having complained so much of the plague of mice, which has caused wholesale destruction of the hornbeam and also of basswood and beech, while oak remains intact. The resultant usurpation of the weeds and grasses make it necessary to obtain regeneration from self-sown seeds of hornbeam or beech and to adopt the planting of spruce. The spruce seems to do particularly well. A plantation of spruce 55 years old, planted originally in alternation with elm, is as fine a stand of spruce as obtains anywhere in Germany. The beech mast of 1909 has been spoiled by a plague of black snails which are said to feed at night, defoliating the beech seedlings absolutely.

Such portions of the range as are not allotted to oak are regenerated in beech and hornbeam, which are meant to make up two-thirds of the growing stock. The remainder consists of pine and spruce, planted, or, in the case of pine, raised from seed. In addition to these, larch is being planted on a larger scale than formerly.

The oak trees dating back to the early coppicing system have a very coarse grain and seem to heal the scars of old branches particularly well. The growth of the oak is very uniform and fine. For the oak timber, a very high price is realized, especially for logs showing a pinkish color at the ends, and further for straight logs of small taper. The highest grade of veneer oak brings from $300 to $400 a cubic meter, while the second class of oak brings from $90 to $180 a cubic meter. This is equivalent to an average price of $30 a thousand feet for timber of all grades. The average price received for cord wood of all grades is $9.

The estimate of a fairly typical strip through a stand of beech and oak showed 102 beeches an acre with an average diameter of 10 inches (beech being 100 years old), and 2508 board feet of lumber. The oaks on the same strip numbered 23, with an average diameter of 26 inches, and a total of 13,189 board feet. The average annual increment is about 160 board feet an acre.

The roads throughout the Gramschatz range are rather poor, owing to the deep soil and the poor grade of stone available for road building within the forest. About $4000 is being spent annually for the construction of permanent roads.

11 HEIDELBERG CITY FOREST

The city of Heidelberg owns about 7000 acres of forest land. Originally the mountain sides and plateaus about Heidelberg were covered with decrepit hardwood forests, but now most of the forests situated more than 800 feet above the city are softwoods. The spruce stands, 50 to 65 years old, are excellent but have suffered considerably from drought in 1910, and also from snow and ice. A thinning was made in the 50 year old spruce in 1903 which netted $30 an acre. Then came severe damage resulting from snow and ice which made it necessary to remove the damaged trees, netting another $30 an acre, and the thinnings made necessary by the more recent drought yielded a further $10 an acre. In spite of this the spruce forests look dense enough and one would scarcely believe that so much material had been removed. The soil itself is valued at $50 an acre. The growing of spruce on these high slopes of the Heidelberg forest appears to be particularly remunerative to the city, as peeled pulp wood brings in the woods a price of $8.75 to $9.50 a cord.

The plateau portions of the forests contain considerable Scotch pine of inferior quality which, however, is sold for box material

Plate 17

A Spessart oak, estimated to be about 700 years old, containing 9 cords of wood, including veneer logs which will sell for over $500

at $11.50 a cubic meter with bark. This material is in great demand for the manufacture of ammunition boxes and the recent wars and the preparations for war seem to have caused a great increase in the price for the lower grades of Scotch pine.

At the base of the mountain slope just above the city is an old chestnut orchard, planted privately about 125 years ago for the production of chestnuts. Cheap transportation from the south has ruined the local chestnut market and this orchard, on a slope too steep for agricultural purposes, was purchased by the city about 60 years ago. The trees were originally in rows about 20 feet apart. The chestnut logs obtained from this stand are cut into large billets and exported to Holland where they bring about $20 a thousand board feet and from them is manufactured tight cooperage for the export of brandies. Following the removal of the largest trees there occurred a wonderfully fine regeneration of chestnut, which seemed to the local authorities an unheard of thing. They are now cutting the chestnuts downward from the top of the stand as fast as the regeneration progresses. Mixed with the chestnut regeneration is some maple.

Black locust, of which there is quite an abundance scattered along the lower slopes, brings a price of $10 a cubic meter for spokes and hubs.

On the higher slopes and plateau to the north of the city the forest was originally all hardwoods, but with centuries of misuse they became unprofitable and were for the most part transformed into coppice hardwoods, while the soil became dried and sterile. With the beginning of the last half century these slopes were planted mostly by seed planting to Scotch pine below and spruce or fir above with considerable larch intermixed. This was done because it was believed that the more modest conifers would have a chance to succeed and to become profitable here where the hardwoods had failed. That they have paid is doubtless true, but the result has been the formation of a vast even-aged stand of conifers, often subject to severe snowbreak, windfall, and the ever present danger of a vast forest fire. The general tendency, now that the conifers are well established, is to break up these even-aged stands into small compartments of varying age and species and wherever the soil and exposure warrants it, the introduction again of hardwoods.

On one of the upper slopes is to be seen the present day result of the planting of the so-called " Jäger's mixture." Fifty years ago or more there was planted here a mixture of seeds of Scotch pine, spruce and larch. Today it looks like a pure Scotch pine stand from

a distance, the pines being 8 to 10 inches in diameter, a few of the larch have succeeded, but the spruce have remained suppressed from the first and are but 2 or 3 feet tall beneath the pines. That they have all lived shows the wonderful power of spruce to withstand suppression. Beginning at the top, Oberförster Krutina, who is in charge of the Heidelberg forests, started a few years ago gradually to take out the pine, with the result that the spruce has developed rapidly and has apparently lost nothing in vigor due to its half century of suppression.

The growing stock of the Heidelberg city forest has more than doubled in the past 75 years, as has also the annual cut. It is a startling surprise to read in detail, from the working plans, the amount and variety of forest products that this city forest produces annually, with the maximum production apparently not yet in sight.

On the brow of the high plateau to the south of the city and looking toward the Rhine river valley is a forest experimental tract which contains even-aged stands of Douglas fir, Engelmann spruce and other exotic species. The arboretum contains many interesting groups of trees and shrubs, among them being Juniperus sabina, Juniperus virginiana, Tsuga canadensis, Cedrus atlantica, Sequoia washingtoniana (36 inches in diameter and 37 years old), Nyssa sylvatica, Ginkgo biloba, Abies polita, Abies pinsapo, Pinus peuce, Pinus monticola, Pinus lambertiana, Thuya plicata, Thuya occidentalis, Chamaecyparis lawsoniana, Cedrus deodar, Hicoria alba, and many others.

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